Major industrial risks. Discussions on territorial approach and risk mapping

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Abstract

The explosion of the AZF chemical plant in Toulouse, on 21 September 2001, dramatically revealed an old problem of industrialised era that is the vicinity of industrial plants and urban areas. With the 30th My 2003 new law [1], in particular with the Technological Risk Prevention Plans (TRPP)[2], stakeholders can't now ignore the importance of territory in risk assessment. The objective is to identify major stakes for the society and their vulnerability for a better land use planning. But this method needs analytical and synthetic tools, as GIS[3]. Indeed, GIS permits experts to structure the data and enables them a spatial lecture of risks. So stakeholders can see and have a concrete representation of risks on their territory, and maps become common discussion and negotiation tools. But that requires understanding in what risk space-rating and mapping need an interdisciplinary vision and a global approach of a same territory. In the context of a PhD study in collaboration with INERIS and the research laboratory GEOSYSCOM, we try to develop a methodology for major industrial risks assessment, based on map and spatial analysis allowed by GIS.

Key words: stake, vulnerability, major industrial risk, GIS, Risk-map

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[1] law n° 2003-699 relative to technological and natural riks prevention and to damage repairing.
[2] In French Plans de Prévention des Risques Technologiques (PPRT)
[3] Geographic Information System

Introduction

In France, the 30th July 2003 law states clearly the will to enforce new regulatory measures, in order to protect the populations concerned by industrial risks. Technological Risk Prevention Plans **(TRPP)**, mostly based on a risk map, are now required. But, to realise an adequate risk map, we need to understand and define the concepts that are linked with risk assessment and management, and to create a relevant method for risk mapping in consequence. Indeed, in a context of land use planning we need to consider risk map as a real assessment and management tool. And this specific context highlights the importance of notions of territory, stakes and vulnerability, which are not enough considered in actual studies. We need a concrete knowledge of spatial and social organisations and vulnerability on a territory. Risk mapping and GIS could then help to deal with the complexity of territories and of major industrial risks. But we ask today in what measures we can assess and manage this territorial complexity, that spreads beyond boundaries and territorial traditionally used structure. Knowing that, several questions can be highlighted, in relation with the different step of our study.

First, to understand the context and the finality of our study, we need to wonder:

- What do we globally represent and what actors and stakeholders are concerned?
- How is the map understood and used by different stakeholders?
- How can we define industrial risks on a territorial point of view?

Secondly, we need to think about the approach we will use for risk assessment and the risk mapping method:

- How to represent risk on a map, what conceptual approach we have to choose?
- Does risk mapping have to be considered as an ordinary description support or as a real tool for reflection, negotiation and decision process?

Lastly, we have to think about the method and the tools:

- What are we able to produce as representations of our present complex territorialities, of which inherited forms are outmoded?
- How to represent risk through pedagogic and adequate maps and symbols?
- What can GIS bring to us in the lecture and analysis of complex areas?

To try to answer to those questions, and in order to situate the role of the map, we will explicit the notion of risk, and in particular our approach of the territorial vulnerability and the pertinence of the notion of stake. Then we will demonstrate in what major industrial risk mapping is strategic, and intrinsically in relation with the notions of territory, risk space rating and complexity. Finally we will argue on the interests of an "industrial risk GIS".

1. The present risk mapping in France

Mapping the risk require to understand the context of its use and the message it has to communicate. As the map translates our representations of a phenomenon in a given instant, it is different if we make it in an optic of research, to divulge results, to communicate or for public participation. It is in this context that we situate the interest and the finality of risks mapping. And it is so important to define exactly what terms are relevant according to the needs and the level of details of the studies.

1.1. The map as a public information tool: simplified definitions and methods

The cartographic tool can be used in very different contexts and has a lot of languages and forms within the type of person involved. Thus, we already find industrial risk maps, in particular in local authorities services and offices. These maps are simple, pedagogic but non-dedicated to analysis either to help decision-making. We can find them in preventive information documents[4] that local authorities have to realise in case of a risk on their territory. For example, the figure bellow is from the DDRM of the Isère department and represents the industrial risk at a large scale. The figure 2 presents another example, at a different scale. It shows the perimeters of dangers of industrial plants that are considered as risk zones.

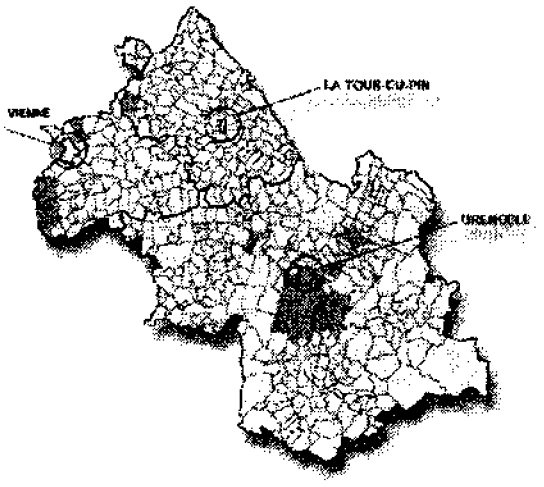

Figure 1. Industrial risks in Isère issued of the DDRM (www.irma-grenoble.com)

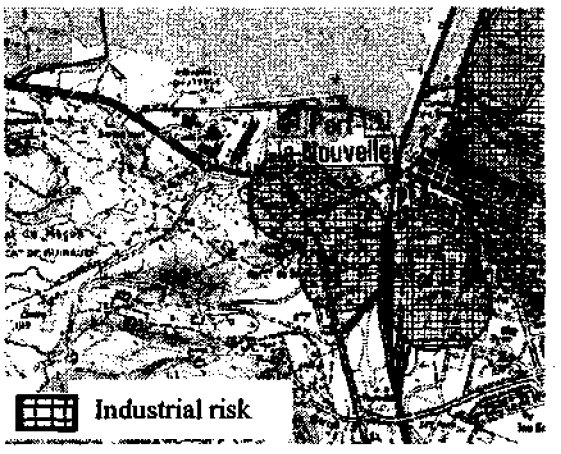

Figure 2. Industrial risks in Port-la-nouvelle City issued from the Aude Department DDRM (www.aude.pref.gouv.fr)

These cartographic documents, interactive and available on Internet, permit the local authorities to communicate on risks in their community, and to diffuse more easily the information.

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[4] *Dossiers Communaux Synthétiques* (DCS), *Dossiers Départementaux sur les Risques Majeurs* (DDRM) or *Dossiers d'Information Communal sur les Risques Majeurs* (DICRIM)

But, if these documents are for information use, They remain very incomplete for other uses, even concerning the employed notions. Indeed, these documents are called risk maps but in fact they are only danger maps, representing perimeters of danger overlapping urban spaces. So these documents are based on the simplistic approach saying that:

Risk = hazard

Moreover, these documents don't consider the territory and their characteristics, either the notions of stakes or vulnerability. These concepts will be necessary for another type of studies and mapping, as risk assessment and management tools. And in that context, there are some conceptual problems that interfere with the quality of the studies, and by extension, on the quality and the relevance of the map.

1.2. The map as an assessment and management tool: the example of the actual Risk Prevention Plans (RPP)[5]

In France, the Risk Prevention Plans are statutory tools that permit the local authorities to manage the risk on their territory, in the context of land use planning and risk prevention. At present, They essentially concern natural hazards and are classified by types of risks (flooding, fire, landslides, etc.). Maps define precise zones of risk and the consequences in term of urban development and management.

These RPP present three types of maps:

- The first represents hazards. Each type of hazard has a specific map. The severity of the danger defines the hazards zoning.
- Another map represents the stakes on the concerned territory. It is used to know what is exactly exposed to a hazard. This map is dedicated to classify specific zones that must be protected and how they must be protected.
- The last map is the crossing of both maps. This last map will be used for land use planning and represents the « reglementary zoning» that says if urban spaces can be developed or not, if we can build new urban areas or not, and if we can, in what conditions? This map is a reference for land use planning and all territorial decisions in consequence.

Then, the main difference with the information maps is that these documents take into account the notion of stake, in relation with the notion of territory. In the RPP guides, a stake is defined as *what the community can lose* or as *persons, goods, means, and patrimony, susceptible to be affected by a phenomenon.*

Risk = hazard x stake

This approach will help the decision making at a local scale and permits the stakeholders to negotiate and discuss the zones and the land use.

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[5] In french, Plans de prévention des risques, PPR.

1.3. Map as a research tool

In risk studies, risk definitions appear more complex and require specific approaches and understandings. Each approach has its own definition and it remains difficult to adapt some of these studies to a practical need in present risk assessment.

Notions of vulnerability, stake, even risk are complex and the studies try to be very exhaustive and to go further some simplistic approaches used at present. The result is that this situation can create some incomprehension with the practical needs of local authorities, when they are informed about it. The maps that result from these works are very interesting and can be very relevant for risk assessment. But they stay inadequate to the present risk management, because they require very long analysis, a lot of data (that is not always adequate in some contexts), and overall a particular understanding of the complex concept of risk. What's more, they are often non-adapted to actors' perceptions and representations. Finally, the results of these researches are not used as they could be because they might stay disconnected from the experience and point of view of stakeholders.

Those examples highlight comprehension shortcomings between **universitary** and professional worlds. Both might better collaborate to take benefits of their own experiences and points of view. In our PhD study, we want to go through these problems and try to develop a method that take into account the practical needs and points of views of all stakeholders, having a scientific but practical and pedagogic approach. This requires defining exactly what is relevant in term of notions, definitions and finality.

2. Risk with a spatial and functional approach

In France, risk is differently defined depending on the type of hazard considered and the finality of the study.

In industrial risk assessment, risk definitions and mapping are mainly technical, focused on hazards. Risk is then considered as a product of probability and severity, determined by effect thresholds.

Risk = probability x severity

In social sciences, the definitions are based on a different approach, inspired by natural risk studies. According to that, probability and severity are only considered as hazard components, but don't define the risk in totality. This hazard is crossed with vulnerability [1].

Risk = Vulnerability X Hazard

According to us, these definitions have to be implemented. The territory is an entire component of risk, an exposed element that have to be took into account. It can indeed be vulnerable by its intrinsic properties. What's more, we also have to consider the stakes that are concentrated in this territory and that can also be vulnerable. Thus, damages are,

on the one hand, due to intrinsic characteristics of a hazard, and on the other hand, to major stakes and territory intrinsic vulnerability. It is so the product of stakes on a territory, both qualified by a degree of vulnerability, and of a hazard which creates a risk.

$$\textbf{Risk} = \textbf{Territory}^{(V)} \times \textbf{Stake}^{(V)} \times \textbf{Hazard}$$

But we need to define what we exactly mean using stake and vulnerability notions, and what is their role in risk assessment and management. Indeed, stake and vulnerability are used in a lot of definition and maps (as in the **RPP** studies). But they remain very vague and their understanding can change within the context and the stakeholders. This confusion can create problems for risk assessment and risk mapping, because the messages and the terms used are not clearly identified. These notions are very strategic if we base our studies in the precise aim of risk and crisis management, and we will argue on it.

2.1. the role of vulnerability in risk assessment

The following definitions permit us to understand what are the priorities in term of risk management and the role of all the concepts in risk assessment and risk mapping. It is since this conceptual step that we will **define** the finality of risk map and the adequate use of employed terms.

2.1.1. A strong but vague concept

Despite it current use in a lot of situations, vulnerability is still difficult to define. It is a strong concept but it remains vague because of it use in various disciplines (industrial engineering, health, geography, psychology, etc.). Then it seems necessary to clarify our position at terminological and methodological levels.

In general, vulnerability can be characterised by society's resistance and resilience capacities. In other words, it is the propensity to suffer damages, in relation with the society's capacity to face a hazard, whatever it origin.

The table 1 shows the diversity of approaches and vocabulary used to define vulnerability. It is based on an inventory of different terms employed in 40 different definitions chosen in the 2004-year publications **[2]**. This example highlights how various are the utilisation of this concept, how difficult it can be to communicate with the adequate words to different persons. Moreover, these words are likely to have different meanings according to the country or the structure involved. And this semantic detail is very important in term of communication and negotiation.

Table I: 2004 most employed terms for vulnerability
Adapted from [2]

Term employed	Frequency of appearance
resilience	1
Weakness	6
Degradability	1
Fragility	2
Damage	4
Consequences	3
sensitivity	3
Severity	3
Degree of loss	5
susceptibility	13

2.1.2. The need of qualitative and systemic approach

To go further and to try to understand all the components of the vulnerability, we base our approach on Robert **D'Ercole's** studies **[3]**. He explains that vulnerability can be defined and analysed according to two different but strongly complementary approaches.

The first, and the most employed, is quantitative. It considers vulnerability as a rating or a percentage of loss, of damage in case of a catastrophe (human lives, goods, and various values). This damage assessment is often limited at physical aspects of vulnerability (mostly resistance of structures). For engineering purposes for example [4], vulnerability is a mathematical function defined as the degree of loss to a given element at risk. It is expressed on a scale of 0 (no damage) to 1 (total damage).

Unfortunately real damage often exceed the physical ones. Thus, if as in the case the seismic industrial engineering, we can refer to quantitative analysis to partly assess the structure vulnerability [1], we need also a qualitative assessment (social, psychological, institutional factors, etc.) to assess non-visible and non-physical damages. We must then take into account other definitions, based on a **multidisciplinary** approach, to evaluate major stakes and their vulnerability.

The second approach is qualitative. It is less traditional, implementing a social approach of vulnerability. It is based on structural factors or on the current economic situation which induce an intrinsic vulnerability of the society. These factors can be socio-demographic and economic (demographic growth, areas occupation, socio-economic context, etc.). They can also be **socio-cultural** (acquired knowledge contrasting with perceptions), technical (prevention and protection measures, network, build structures and infrastructures), and lastly institutional, politic and administrative (land use planning and urban management, etc.). The factors of vulnerability depend of the society's cohesion, characteristics and organisation. They are difficult to evaluate because of their nature, often qualitative or half - quantitative, and in relation with the education, the

social and cultural inheritance, and with the populations' and stakeholders' risk perception.

This definition is very complete and quite difficult to understand without a systemic point of view. It helps to realise that a territory is made of different functions and elements that interact and are closely link. Concerning the context of our studies, we want to implement this vision with another notion, more functional. Thus, we consider that vulnerability exists through the presence on a territory of inherited elements and of intrinsic factors of vulnerability, which evolve and interact in space and time. These elements have intrinsic and functional values that contribute to communal well being, to emergency response and post-disaster recovery in particular. We call them stakes.

2.2. Considering major stakes for functional risk management

2.2.1. Notion of dependence

In the context of risk management and land use planning, the territory is considered as a social, economic, and spatial system, with essential elements and functions. When these elements or functions have a value for the society, we call them stakes. This value is determined by their role and weight in the society and by the consequences of their damages or loss at short, medium and long terms. The more important is the value, the more dependent is the society. This dependence of the society towards stakes makes the system vulnerable on it own territory (for example: blackout, supply places demolished, ways of communication destroyed, political and social disorganisation and conflicts, economic loss, etc.). Consequently, these essential elements and functions are called "major stakes" and have to be assessed in priority.

2.2.2. Strategic functions for the society.

These strategic and functional choices can be misunderstood in a local scale (the society interests seem more important than the individual ones). But, at local as at global scale, the concentration of major stakes in exposed areas appears as the first factor of risk. Analysing those major stakes permits us to put forward strategic zones for the society (hospitals, commercial activities, political and administrative authorities, natural resources, etc.), homogeneous or not, and to reveal some spatial and social dynamics and weaknesses.

We can then act to reduce their vulnerability and to be more prepared to face a hazard. Indeed, a simple description of a territory and of the functions is not enough if we want to be efficient in term of risk management. Organising these functions, defining the importance of the stakes, their weight in the society and their vulnerability helps us to map the more vulnerable zones, to classify them and to visualise the spaces where a prevention or protection action is necessary. This is not possible with a simple description map, or it will take longer to identify the strategic zones. Then, we will be able to realise a major stakes map, representing their role and the function they represent

(for example, political, economical, environmental, symbolic, etc.). It will be possible to see homogeneous zones and to study the eventual spatial and social interactions between different spaces and stakes, in a systemic way.

One of the first phases of risk assessment is so to qualify those major stakes. However, according to us, it still exists some confusion because of the difficulty to define it. What's more, as we saw before, notions of stake and vulnerability are often used, as in RPP, but don't have the same meaning depending on the actor and point of view. This has consequences on map message and realisation. The maps can be heterogeneous and bring confusion instead of helping to visualise and analysis spaces.

2.3. Conceptual confusions and consequences on mapping

The amalgam regularly done between the notions of stake and vulnerability testifies of the shortcomings existing in term of definition, assessment and mapping. Stake is often considered as target, exposed element, vulnerability, or even territory. But, for us, these definitions don't express the notions of value, role, weight, dependence, or either priority, that are characteristic of a stake and that make it different from a single function or element on a **territory**.

Then, a map that describes a territory is often qualified of "stakes map", or even "vulnerability map". As there isn't an official method for stake and vulnerability assessment, one considers that territory is synonym of vulnerability and the studies stay poor in term of spatial analysis and qualification of a territory. And as this type of map is few used in risk assessment, the hazard map being the traditional reference, we continue to act in an inadequate way. Studies on stake and vulnerability mapping are lacking. Consequently, this situation creates a distorted vision of a territory that can complicate decisions and actions. The map does not transmit anymore the initial message and the image has no value either relevance relative to the initial finality. The map becomes almost " useless " [5].

However, the majority of experts and stakeholders know that these methods are incomplete and need to be implemented. But, in the context of RPP, and overall **TRPP**, time, tools, cultural and scientific references and comparison are lacking to implement studies, and to pass from territory description to stakes and vulnerability identification and analysis. This is due to a lot of social, political, economic, scientific dimensions that created this situation in time and space, and to the difficulty to take into account qualitative factors in risk assessment. It seems now necessary to implement more adapted and relevant methods, including risk mapping.

3. Major stake and vulnerability qualification

3.1. Context and finality

To identify the major stakes that are concentrated in a specific space, we need local

stakeholders or expert point of view and knowledge. Then, to understand the context and the expectations of the stakeholders, we need to set:

- The finality of the study:
  - What do they want to protect, in normal times and in critical times?

- The material, the data and their use:
  - How to **find** the relevant data? Are there data inadequate? How, from the data collected and exploited, a stakeholder will understand the information and use it?

This first approach enables us:

- To realise socio-spatial models:
  - To highlight places of **centrality**, to identify main elements and functions and their spatial dynamics.
  - To analyse the location and the dynamic of principals and strategic networks, and their relations with neighbouring territories.

- To develop a specific approach:
  - To realise a typology and a space rating of elements and functions according to different administrative and territorial scales (township, region, state, etc.).
  - To define "major stakes" for risk assessment and management (including crisis management).

This approach needs to consider the territory as a system made of different dimensions that interact and that characterise the major stake at a society scale. The conjunction of spatial elements, of economic and political values, social practices and inherited traditions create major stakes. That's why we can't consider the territory only from a specific point of view, that would occult other possibilities. A same space has different meanings and uses depending on the approach and dimensions considered. That's why we need the stakeholders' perceptions and interests to understand their own spatial and territorial logic.

3.2. Approach and first identification

To assess for major stakes and their vulnerability, we have to consider essential dimensions that represent main dynamics that interact on a specific territory and that define stakes. Indeed, stakes are made and defined by our practices, social, economic or spatial organisation and relations. Considering these dimensions permits us to classify the major stake considering their function and role (human, economic, cultural, symbolic, political, strategic or military, environmental, etc.). These dimensions are mostly:

- Spatial. It represents all the spatial and territorial dynamics that are inherited from cultural and spatial development in history. It is the physical and material representation of a **society's** community, identity and way of life.

- Economic and political. This dimension is an economic translation of a society's organisation and activities. It takes into account the political power, the economic weight of the functions and the relations with other territories.
- Social and cognitive. It is the more difficult dimension to consider because of the qualitative and individual aspects to consider. It represents the social perceptions and relations in a same territory and it shows that stake can also be symbolic, defined by cognitive factors sometimes difficult to understand and to consider.

This figure represents the three most important steps for stake and vulnerability assessment. First, we qualify major stakes. Then we specify factors of vulnerability that are intrinsic to the concerned territory. Lastly we specify the vulnerability of major stakes crossing both information.

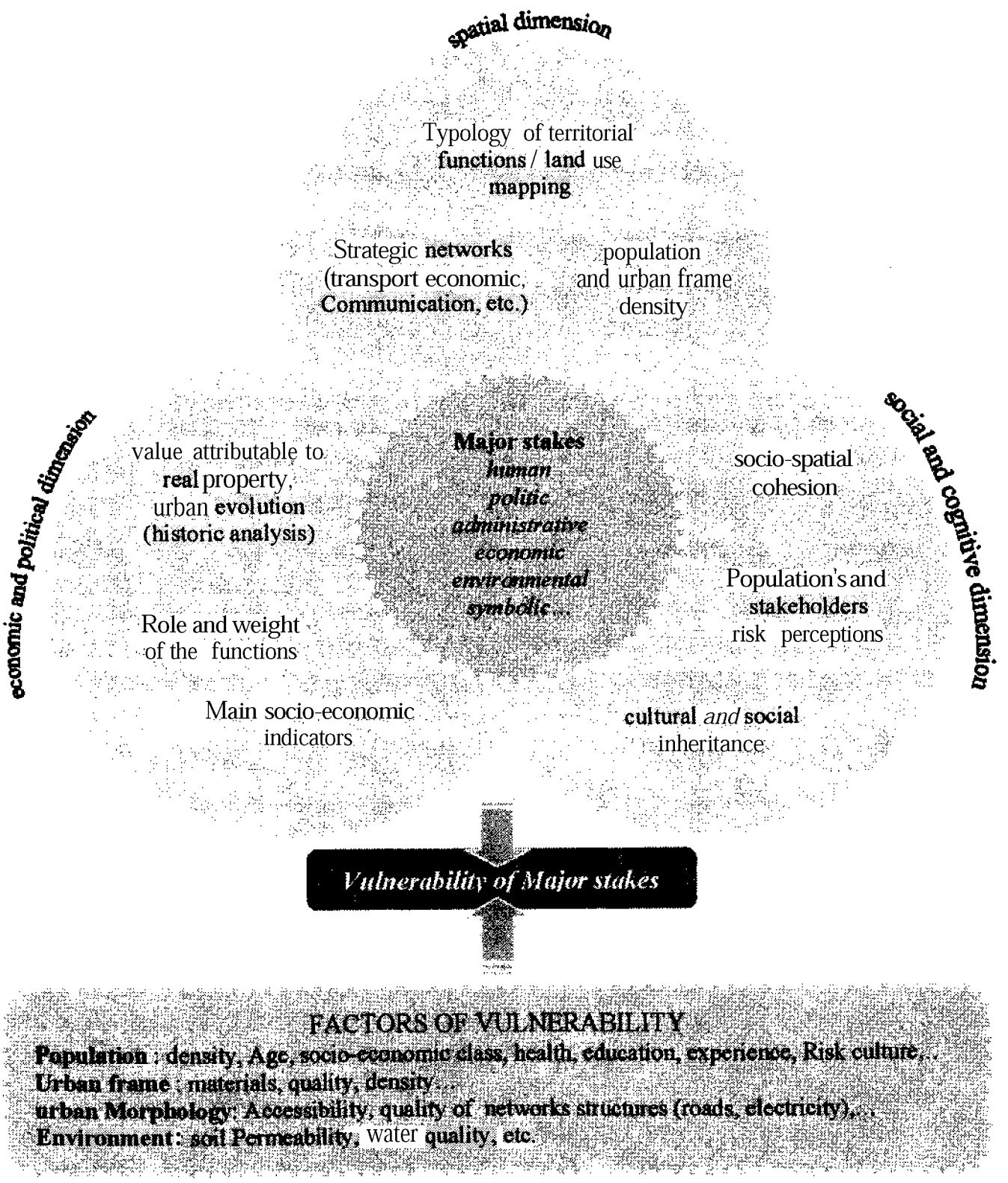

Figure 3. Simplified method for major stakes vulnerability identification

Lastly, this vulnerability has to be organised into a hierarchy according to stakeholders' perspectives. We can obtain a global map representing different levels of vulnerability (see figure 4) and showing where spaces seem more vulnerable than others.

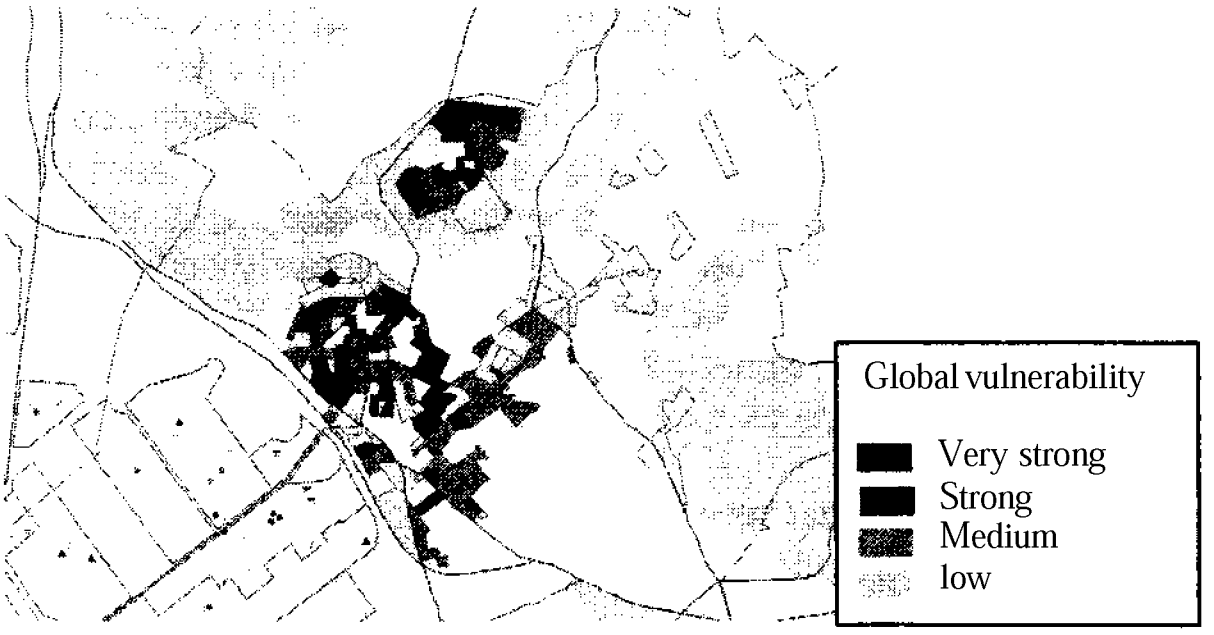

Figure 4. Example of global vulnerability mapping

But the approach remains complicated because we use the experts' and stakeholders' judgements to weight the major stakes and the factors of vulnerability. And they have sometimes very different (and often divergent) interests.

3.3. Main difficulties due to factors of vulnerability assessment

In a context of studies and researches, major stakes and vulnerability assessment needs a detailed knowledge of the concerned territories. It needs to be done in a large time scale to understand all the mechanisms and dynamics of these spaces. This length of analysis and of data finding is then difficult to adapt to the stakeholders' needs and to risk management.

3.3.1. Understanding the factors and Finding data

Most of difficulties are closely due to the qualitative nature of data, and to the socio-spatial complexity. So we have to make relevant choices about factors selection. And it is necessary to justify these choices according to the existing contexts. As it is sure that we will take into account the population density and the type of urban frame, we will also probably consider the age of the population and the accessibility of the spaces.

But this type of approach can be very restrictive and we are likely to occult important factors only because of finding and analysing difficulties. As an example, it is highly probable that we would not consider populations' risk culture or networks structure quality (water, electricity, etc.). Consequently, it seems important to take into account these shortcomings and to know that the results remain partial and perfectible.

3.3.2. Comparing and weighting different factors

The vulnerability is mostly expressed in a qualitative way (such as "low, medium and strong") This classification requires a referential judgement and implies to take political and ethical positions. But, objectivity remains difficult to reach because of the nature of these judgements, subjective so contestable. We must then tempt to find a consensus between all experts and stakeholders representations and interests.

When several factors of vulnerability (from different types and scales: socio-economic, political, economical, cultural, etc.) cohabit on a same territory, to compare and aggregate them can become conflicting:

- On the one hand, to aggregate different factors of vulnerability breed a significant loss of information and can be prejudicial for the analysis and the decision making. A global map representing a general level of vulnerability is not easy to exploit because we don't know the qualitative nature of the factors considered that have been aggregated. But it permits to see what spaces could be more concerned by factors of vulnerability than other, and then to concentrate the efforts and the studies on it.

- On the other hand, the multiplication of analyses and of maps creates also problems for negotiating and for space-rating the risk. Stakeholders need synthetic information and analytic maps could bring too much information without really organising it and without helping the decision making process.

In other words, considering global indexes and synthetic vulnerability maps can seem few adequate but too much information can create confusions and be inefficient. Moreover, if we can develop general and global matrixes, all factors of vulnerability are not relevant in all cases, and a selection has to be made according to the expectations and the context of the study. Stakeholders need to be helped for decisions and need to have the clearest and the most relevant information. And that point is very ambiguous. Because the relevance of the information is difficult to define without a context and is likely to be different within the stakeholders concerned. Each choice can be contradict.

So it seems important to adapt the analysis to a specific context, in order to take into account the demands and the works to realise. That would tell that there is not one general method for risk assessment, and that each case has to be considered in particular. If it is on a scientific aim, to be exhaustive and complete, we will need time and we will not consider practical and political questions in priority. But, if we think overall on operational and emergency aspects, we need to make choices and to concentrate our work on identification, prevention and protection of the major stakes that are vulnerable.

4. Risk and spatial complexity

The simple world is now behind us and, as underline Debardieux and Vanier [5], we have entered in a territorial complexity era. We assist (and we participate) to the multiplication of practices, of exchanges, implying a combination of different areas, temporalities and territorialities. The increasing complexity of the economic, social or political functions and dynamics creates new problems for mapping.

4.1. Complexity and cartography: mapping vulnerability

4.1.1. complexity of a territory

The present complexity is partly due to territory evolution and to society's perception. Moreover, our inherited representations of a territory and the mapping techniques traditionally used are now inefficient to include this complexity in a map. Administrative and territorial boundaries are indeed less and less adapted to contemporary territorial dynamics. The map is then less relevant and limited by formalisms that it would perhaps be interesting to implement.

In risk management, this complexity is characterised by a multiplicity of territorial identities and of stakeholders, which are superposed and have dynamic relations [6]. What's more, the notion of " uncertainty " related to analysis and risk assessment makes also complicated the risk space rating. Thus, mapping vulnerability becomes complex because of the multitude of parameters to consider, being qualitative or quantitative. And today more than ever, risk map is a real stake for risk management being an important support of negotiation and dialogue. The political, economic and social stakes are such that the question of the map can not be occulted. We need more and more referents of our own territorialities, to understand and analyse our practices. The map represents the territory of all stakeholders and permits them to spatially confront their interests. But, if we refer to existing researches on vulnerability, particularly in geography, we notice that, beyond the density of the population, the majority of indicators are qualitative, in relation with social and individual behaviours facing danger. Vulnerability assessment needs a deepened knowledge of concerned society and territory, and can only be done in a long time scale, because of spatial, temporal and social scales (from the individual to the collective) that interact.

4.1.2. Complexity of representing a territory

From a technical point of view, all mapping meet obstacles, and we notice that the cartographic language can't express everything! Putting a large number of different visual components on a map has limits, in relation with the physiological incapacity of the human perception and of the simultaneous vision [5].

To help decision and consultation, risk map has to be easily understood, or it would be useless. What's more, once realised, the map becomes a public document, arguable and

contestable. It comes out of it technical context and lose the value that the authors put in it. It interpretation can then be very different from the initial message. It can create virulent reactions from local stakeholders, who trust to map extreme referential and spatial precision and temporal suggestiveness. They forget then that the map is not the reality, is subjective and is likely to evolve. Moreover, the finality of major industrial risk mapping is not the map in itself, but is the representation and the interpreting of a particular context, of spatial and social relations. It permits a particular reading of the risk on a territory, without forgetting the limits of drawn boundaries and thresholds, dependent on chosen concepts and of assessment methods. That's partly why we have technical difficulties to map this territorial complexity, overall in an adequate way.

4.2. Interest and utility of GIS.

GIS appears like an interface between concepts and stakeholders' needs. It is a powerful reflexive, analysis and communication tool that remains however complicated to use if it is not well-structured [7]. What's more, data collect, integration and processing require above all competencies of a specialist, and not these of a manager. So we have to estimate what really are the advantages of a GIS in risk management.

Coupling methods of risk assessment and a GIS enables us to advance simultaneously on several topics and on important studies for risk management. On the one hand, we contribute to the knowledge and prospective improvement in major industrial risk assessment; and on the other hand we promote and assess new working methods through GIS and spatial analysis. It means to understand how the GIS can combine, confront, associate, proceed those information for a global and synthetic vision [8].

In that purpose, we need a pragmatic approach:

- Why scientists and stakeholders are they interested in GIS? What do they think GIS will bring about?
- How do they perceive the utility of GIS and what do they wait from it?

GIS, through the three components it offers (space, time, observable reality), is able to bring a solution to the social expectations, and to constitute a main of answer. The important on a GIS are not the quantity of data that we can collect, but it is overall the data structure that can create information and knowledge. And these results enable us to understand territorial and spatial features that can interfere with land use planning and produce particular risks. The key point is to create a logical and structured method.

So, this is from the explanation of the concepts, of their use and of their relations that we will deliver a clear message using maps. But we have now to find the adequate map symbols that can be understood and assimilate for all readers ad users, knowing that they are often few sensitised to this kind of language.

5. conclusion

In France, major industrial risks mapping, and in particular major stakes and vulnerability representation, remains to explore. It certainly offers large possibilities for analysis, management and negotiation, in condition to respect the entire process of GIS and map conception, promotion and use. Indeed, even "bad maps" communicate and the question of what a good map is, according to cartographic conventions, is to ask how well it communicates with it users [9]. The aim of our studies is to offer a tool for dialogue and communication to all stakeholders, even non-specialists, for a better land use planning. INERIS, by its technique and scientific knowledge of the industrial hazard and its methods of risk assessment, can develop a method of assessment and of mapping through GIS. The project has then a specific finality, conciliating of the industrial engineer sciences and these of social and spatial sciences. But that means to understand all the concepts and stakes inherent to risk assessment and management complexity, and overall to consider the map as a " *symbolic mediation between the human and his world* " (Torricelli, in [5] p. 148).

References

[1] Trémolières A. (2002) *Enjeux et vulnérabilités des centres de Quito (Equateur), caractérisation et impacts à l'échelle du District Metropolitan de Quito,* mémoire de maîtrise, Université de Savoie (CISM) / Institut de Recherche pour le Développement (IRD), 171 pages.

[2] Griot C., Ayral P. A. (2002) terminologie en science du risque, recueil de définitions, GEM, 87 pages.

[3] D'Ercole R. (1998) Approches de la vulnérabilité et perspectives pour une meilleure logique de réduction des risques, in PANGEA N°29/30, juin-décembre 1998, pp.20-27.

Bartels C. J., Van Beurden A. U. J. (1998) *Using geographic and cartographie principles for environmental assessment and risk mapping,* in Journal of hazardous materials (on-line), vol.61, n°1-3, pp.115-124.

[4] UNDP, DHA, Disaster Management Training Programme (1994, second edition) *Vulnerability and risk assessment,* 69 pages.

[5] Debardieux B., Vanier M., sous la direction de, (2002) *Ces territorialités qui se dessinent,* Editions de l'Aube, DATAR, 267 pages.

[6] Propeck-Zimmermann E. (2002) *RTM: Concertation et communication à l'aide de la carte,* in Préventique-Sécurité n°65 sept- oct., pp. 36-39.

[7] Propeck-Zimmermann E., Ravenel L., Saint-Gérand T. (2002) *Cartographie des Risques Technologiques Majeurs: nouvelles perspectives avec les SIG,* in MappeMonde n° 65 (2002.1) pp.17-21.

[8] Bavoux J. J., (2003) *La géographie: Objet, méthodes, débats,* Editions Armand Colin, collection U-Géographie, 239 pages.

[9] Ramella A., Bobbe A., et al. (1998) *Risk maps: theoretical concepts and techniques,* in Journal of hazardous materials (on-line), vol.61, n°1-3, pp. 299-304.